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COORDINATED INFORMATION SERVICES for a DISCIPLINE- OR MISSION-ORIENTED COMMUNITY

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INTRODUCTION

1

Generally, adoption of a multi-access computer network is promoted on the basis of increased accessibility and economy of computational and data-bank resources for a distributed community of users. But visualize this resource-sharing computer network as a general-purpose digital-packet transportation system linking resources, processors, vendors, brokers, customers, etc.; then consider that the existence of such a transportation system will inevitably stimulate growth of an information market involving many processes, products, and services. A distributed community availing itself of such a transportation system should rightfully count on such market development for much of its payoff from its early investment.

1A

In particular, the "Knowledge Workshop" services described below will grow to become very important to network-coupled communities that are involved with a common discipline or mission -- my judgement is that this use of computer networks will come to dominate over the purely computational use in scale and generally perceived social worth, with today's type of computer services being seen as but a special subset of the tools integrated into a coherent knowledge workshop.

1B

THE KNOWLEDGE WORKSHOP

2

In using the term "knowledge workshop", I build directly upon terms "knowledge work" and "knowledge worker", whose special use I first came across in reading Peter Drucker (Reference 1). He develops a much larger theme about these concepts in Reference 2, adding terms such as "knowledge technologies", "knowledge economy", and "knowledge society", and pointing out that the growing level and importance of knowledge-work activity in our society will produce a discontinuity in our cultural evolution of a scale commensurate with that of the industrial revolution.

2A

The knowledge workshop is the specially provided environment in which knowledge workers do their knowledge work. We can talk about a small knowledge workshop for an individual, or a large knowledge workshop for an organization. Knowledge workshops have existed for centuries, but here we consider maximizing their effectiveness by systematically evolving tools, methods, etc., with heavy dependence upon the new technologies of computer time sharing and networking. (In the text below, read "knowledge workshop" for "Workshop".)

2B

Basic workshop functions must serve the daily handling of the users' working information -- of their notes, things-to-do lists, memos, letters, designs, plans, budgets, announcements, commentary, proposals, reports, programs, documentation, item-control catalogs, etc. And before it can sensibly be of much value, we believe that a Workshop has to provide for the grubby cut-and-try detail involved in the minute-by-minute, day-after-day worker's handling of this information: in its composition, studying, commenting upon, arguing about, modifying, communicating, publishing, presenting, etc. There are many exciting, elegant tools in the offing -- superlative graphics, artificial-intelligence services, etc. -- but their serious application will only be sensible within an integrated Workshop, and in a manner whose associated conceptual and procedural skills are consistent with those of tools and techniques that support the basic Workshop functions.

2C

For the past ten years in the Augmentation Research Center (ARC), at Stanford Research Institute, we have concentrated in succession on exploring the computer augmentation of knowledge workshops, first for an individual, then as extended for a project team, and then for a network-coupled, distributed community (See Reference 3). Over the past three years we have developed a beginning set of prototype "community-Workshop" services on the ARPANET, as associated with our serving as the Network Information Center (NIC).*

2D

[Footnote] *The following agencies have contributed components of direct support to this ten-year development: The Information Processing Techniques Office (ARPA), Langley Research Center (NASA), Rome Air Development Center (USAF), and the Information Systems Branch (ONR).

2D1

Our focus all along has been toward supporting R&D workers, and we have followed the empirical, bootstrapping approach of doing as much of our own work as possible in our Workshop, continuously building, using, and evolving it. Our Workshop services are supplied by a large software system that we call NLS, running under TENEX on a PDP-10. It provides a large repertoire of functions to display terminals (DNLS), online typewriter terminals (TNLS), or via deferred-execution of commands and text from offline typewriters as accumulated on cassettes or other intermediate storage (DEX). Hardcopy output is available on typewriters, online printers, or through an offline phototypesetting device providing publication-grade quality for multi-font text, computer-directed graphic constructs, or scan-stored diagrams.

2E

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Besides giving constant, pragmatic attention to the needs and possibilities for evolution of support functions and working methods, we have had to struggle with what is a soul-wrenching burden for people whose orientation is toward exploratory development -- trying to meet the absolutely necessary requirements of organizing, documenting, maintaining, and operating the hardware/software and clerical services towards being responsive and reliable, minute after minute and day after day.

2F

Technology has reached a state warranting much more activity explicitly applied toward the evolution both of better Workshops, and of a coherent discipline associated with Workshop-system development; for this to happen, it is obvious that more people must take on the challenge of becoming "Workshop architects", and that more pilot-plant Workshops need to be set up for exploratory support of real knowledge-work activities. There are (will be many) approaches to be tried besides ours, of course; but to do our bit toward accelerating this process, we intend to share and extend our developments and knowledge by making our Workshop tools available for exploratory application in distributed, modular, pilot-Workshop sites, and by offering close collaboration with the pilot-Workshop architects. (Note below that an important Workshop feature being offered is designed to facilitate such "distributed collaboration".)

2G

PROTOTYPE COMMUNITY-WORKSHOP SUPPORT

3

We aren't ignoring exploratory use within localized organizations, but we are committing a substantial portion of our energy toward the early, exploratory use of knowledge-workshop services to support distributed, network-coupled communities. There are two special reasons for this commitment:

3A

The first reason concerns relative payoff: if a service facilitates hobnobbing via terminals, there is extra value when this supplants air fare and a two-day trip in contrast with supplanting a walk down the hall; there is more payoff from relatively costly augmentation services when they facilitate collaboration among participants who are distributed rather than among those who are already clustered.

3A1

The second reason concerns a wider awareness of the possibilities for augmenting knowledge workshops, and a

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wider interest and involvement in their accelerated evolution -- things we hope to enhance by facilitating community-Workshop exploration. We find that toward significant Workshop innovations a user needs a sort of warming-up process before gracefully giving something new a try. Thereafter, in the right environment, he will "naturally" adopt successive stages of significant new Workshop techniques. This process is noticeably facilitated by steady exposure to the products and conventions of Workshop services; and it helps considerably to have a variety of opportunities and materials to stimulate and support the "giving it a try" -- for instance, to try a little online dialogue with a distant, more-advanced colleague, dealing with materials already in the community data base. Also, if a new stage of service is available in this "community way", a large number of people will benefit from the lower threshold of investment and determination needed to give it a try.

3A2

Following is a brief description of community-Workshop applications that special communities can consider exploring. The sequence represents an explicit progression, beginning with tested techniques whose "cultural shock" and financial investment are relatively low, and offering paced, open-ended evolution with time, experience, and perceived payoff. We are arranging for computer support of these services by a commercial-quality "utility" service connected to the ARPANET. We will provide this Workshop support (at cost) over the Network to selected subscribers for setting up and exploring prototype, augmented-Workshop applications. We expect the Workshop toolkit to be continually expanding and improving, and plan for much of the evolutionary energy and direction to come from the subscribers.

3B

COLLABORATIVE DIALOGUE: We offer computer aids for the composition of messages and for their subsequent reviewing, cross-referencing, modification, transmission, storage, indexing, and full-text retrieving. A "message" may be one word in length, or a hundred printed pages. In any message there may be formalized citations pointing to specific passages in prior messages, so that a group of related messages becomes a network of recorded-dialogue contributions. There is also: automatic delivery of messages; full cataloging and indexing; online accessibility both to message notification and to the full text of all messages; and open-ended storage of the dialogue records. These services enable a community of people who are distributed

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in space and time to maintain recorded, collaborative dialogue at a new degree of effectiveness.

4

Then to support "real-time" remote dialogue (teleconferencing), we have the following facility: Any two DNLS users can "link up" at any time, so that each party sees a common display view, including both his and the other person's cursor; either party is able to point or control, and they mutually have access to the full range of Workshop functions, over any of the online information. The responsiveness and bandwidth of the ARPANET provide remarkably good support of our highly interactive DNLS service to remote display users, so that when used to supplement a telephone conversation, the speed and flexibility of this shared, "augmented blackboard" brings a new quality to teleconferencing that is really quite dramatic.

4A

DOCUMENT DEVELOPMENT, PRODUCTION, AND CONTROL: We offer a rich set of computer aids for the composition, study, and modification of document drafts, and for automatically generating high-quality photocomposition output with flexible controls for font-designation and formatting, to enable the production of publication-grade hardcopy (printing masters, or microform masters). There are processes for collaboration between several writers, and with an editor, in the process of evolving a final draft. Included among such helpers can be experienced production people to help in laying out a finished document, in inserting proper designations for specifying font, size, and density of different character strings, and for managing footnotes, cross-references, tables of contents, indices, etc. There are also aids for the people who must keep control of changes, new-version distributions, etc., and provide the indexing to complex documents or sets of documents. Planned improvements include facility for handling complex graphic portrayals and extensive special symbols.

5

RESEARCH INTELLIGENCE: The provisions within the Dialogue Support System for cataloguing and indexing internally generated items also support the management of externally generated items -- bibliography, contact reports, clippings, notes, etc. With these centrally supplied (therefore uniformly available) services, a community can maintain a dynamic and highly useful "intelligence" data base to help it keep up to date on external happenings that particularly affect it. Microform distribution can provide for mass replication of this data base at remote sites, and computer-generated indexes or online retrieval can facilitate access. Citations of external items from within the

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internally-generated dialogue base -- in the form of annotations, miscellaneous commentary, or supportive references -- offer computer-sensible interlinking of the external information with the internal, and considerably facilitate browsing, retrieval, back-citation searching, etc.

6

The Community could choose to operate a special Information Analysis and Integration Center as a nucleus to this activity, but the notes and private-collection records of individual users, integrated into the "recorded dialogue", could well add the more value. (Reference 4 describes some developments and possibilities for support of research intelligence.)

6A

COMMUNITY HANDBOOK DEVELOPMENT: We are extending the above services toward the coordinated handling of a very large and complex body of documentation and its associated external references. I use the term "superdocument" to refer to such material when integrated into a monolithic whole. There are a number of important applications for a system that facilitates the responsive development and evolution of a superdocument by many (distributed) individuals. In particular, for either a discipline- or project-oriented community, one very important application of a centrally available "superdocumentation" service would be to maintain "The Community Handbook" -- i.e., a uniform, complete, consistent, up-to-date integration of the special knowledge representing the current status of the Community.

7

The Handbook would include: principles, working hypotheses, practices, special-term glossaries, standards, goals, goal status, supportive arguments, techniques, observations, how-to-do-it items, etc. An active community would be constantly involved in dialogue bearing upon the contents of the last formal version of its Handbook -- comments, errata, suggestions, challenges, counter examples, altered designs, improved arguments, new experimental techniques and data, etc. Constant updating would provide a "certified, community position structure" about which the real evolutionary work would swarm; flexible aids for online "navigation and view generation" would be very important, as would the facility for automatic publication (especially into microform editions).

7A

COMPUTER-BASED INSTRUCTION: If relatively widespread applicability of Computer-Based Instruction (CBI) were suitable for the Community, then there would likely be advantage gained from pooling resources and utilizing a community-coordinated instructional service. For a community also utilizing other centrally managed Workshop services of the scope and power

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described here, there would be considerable overlap between them and their CBI processes and activities.

8

Even though CBI has more visibility and momentum as a discipline than does CBKW (Computer-Based Knowledge Workshop), it seems inevitable that the former will end up as being but a special, integrated component of the latter. One should expect CBI service anyway in his Workshop, and he won't expect to go to a different terminal or to learn a different set of interactive concepts and skills to get that service; and also, that service will often bear directly upon concepts and matters deeply embedded in the workaday domain of his Workshop system.

8A

It is also very probable (to my mind) that communities will ultimately integrate their Handbook and CBI techniques so that their monolithic, superdocument Handbook would contain the special tags, links and etc. required by the CBI computer processes so that a significant portion of the instructional services would be generated directly from the primary knowledge source, the Community Handbook.

8B

MEETINGS AND CONFERENCES: This refers to assemblies of people, which occurrences aren't likely for a long time yet to be supplanted in total effect by technological aids. In supporting our own ARC meetings, demonstrations, etc., we use TV-projector equipment that projects our regular work-terminal display images onto a movie screen, easily readable in a meeting room having enough ambient light for comfortably reading notes and seeing each other. Images from live TV-cameras or from video recorders can also be projected. We make use of commercial devices for controlling these various video signals -- switching, mixing, and frame-splitting. We can mix two signals to get image superposition, or split the video frame to get a computer-display picture on one part of the screen and a camera image on the other (for example, simultaneously showing the camera view of the user's controlling actions right along with the display responses from the computer).

9

With this projector setup, we use our regular Workshop techniques in meetings to present and explain material from the online data base. It is easy to review and change the agenda and the meeting notes; some meetings operate very profitably in a mode of "collaborative position-statement development", with a facility that for many purposes is far superior to using a blackboard -- it is as though the blackboard now is very easily stretched to make room for new

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notes, edited, scrolled, folded, reorganized, or etc., and any available online material may be copied onto it for integration into the study, re-organization, re-wording, development process. A skilled Workshop user can operate this "blackboard" with enough speed and flexibility that these processes often don't seem to be what limits group progress (in the midst of questions, deliberations, etc.).

9A

Any Workshop user at the gathering can call on part of his own online notes, or use his familiarity with certain material, to bring special information before the assembly. Or, the whole assembly can see the display being controlled by another individual (or assembly) at a remote site, in shared-display dialogue. There are many further technical and procedural innovations to explore in improving the effectiveness of meetings -- e.g. computer-processed bio-feedback, radical changes in the "rules of order", and giving each participant independent use of a private display terminal.

9B

COMMUNITY MANAGEMENT AND ORGANIZATION: Where the Community has conventional, project-management operations, their Workshop can include computer aids for such as PERT and CPM, plus the enriching services of dialogue support, document development, and a "Handbook" system. An extension of the Handbook could contain plans, commitments, schedules, specifications, current-state records of work in progress, etc., with special Workshop tools to support management analysis and control.

10

But also, with the probable increase in the amount and intensity of distributed collaboration within the Community, "committee work" would become more widespread, dynamic, and important. Thus there would be greater dependence upon better techniques for inter-communication and management within the committee-like structures by which a Community goes about its composite business. Harnessing these new techniques will lead to very different ways in which distributed communities can be organized and in which they can go about their business -- and the possibility of considerable improvement here, stemming from relatively modest innovative investments, is an important part of our motivation toward facilitating Community Workshop exploration.

10A

SPECIAL KNOWLEDGE WORK BY INDIVIDUALS AND TEAMS: Assumedly, Community members could avail themselves of the above types of Workshop service in support of their own daily work -- i.e., for other than their participating in community-oriented activities. There are obvious benefits to almost any knowledge worker from

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use of general Workshop facilities such as listed above; and for a team (or any close-working organizational unit) of augmented knowledge workers, there is yet another level of benefit to be gained by adopting new organizational structure and collaborative methods that harness better the new capabilities existing within the Workshop (as extended by a few special team-support tools).

11

Then further, the particular set of disciplines and pursuits which characterize the Community will generally have special computer-based processes and data that are important in its work -- i.e. unique functions and forms in its analytical programs, statistical processes, numerical data, conceptual/analytic models, graphic portrayals of subject matter, etc. Assuming that they are available within the same computer network that distributes the Community's Workshop-support services, then access to these special computer-based resources can be provided to a worker "through" the coordinated Workshop in which he does his other work -- and to a distinct advantage.

11A

In any of this special work, there is basic advantage in having a flexible, powerful facility for managing mixed text and graphics -- composing, studying, modifying, integrating new material into working notes and reports, publishing, doing collaborative dialogue, giving presentations, etc. When doing tasks of this sort in association with his special computer-based operations, it is an important advantage to the worker to do so within a familiar and consistent working environment. Our Workshop flexibly provides for special translation of information passing back and forth to any such "external" computer service, so that for access to a wide variety of such services the Workshop can provide users with consistent conventions and methods in whose use his other Workshop tools would be of maximum support.

11B

CONCLUSION

12

The full sense of what computer networks offer in the way of "resource sharing" contains some special twists of significance here: For one thing, a truly complete Workshop will contain a very large repertoire of service functions, and the evolution, operation, and maintenance of these functions (and their support software) will require highly trained specialists. Any sort of widespread exploration of augmented-Workshop techniques will be very much facilitated by the network's capability for sharing the expertise of such specialists -- by enabling central computational resources

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that they develop and maintain to service distributed users. Note that specialists working from their home Workshop will be able to reach through the network to install and maintain software in remote hardware installations, which will be important, too; but note also that many already-present local computers and operating systems are inappropriate for supporting all of the important Workshop functions.

12A

For another thing, the vocabulary and procedural skill required to harness these functions effectively and smoothly into one's worklife will become very extensive and sophisticated (the pidgin-English approach won't provide the power, and full-statement natural language isn't fast enough), and again special expertise will be necessary to help people through the learning stages as their Workshop matures. Therefore, although the network can very much facilitate bringing into user reach these powerful Workshop tools, it requires the additional network-supported (Workshop) facilities such as teleconferencing to enable a limited number of workshop specialists to give close support to these learning processes, without which the computer services would have much less value.

12B

If exploration of Workshop use were to occur only where there exists both an appropriate local computer system and trained specialists to maintain the software and train the users, there would be a very much slower evolution toward the increased-effectiveness possibilities offered by computer augmentation.

12C

Finally, the "digital-packet transportation system" aspect of a computer network seems quite essential to the practical, effective support of an augmented Community Knowledge Workshop -- which in turn seems to offer a really important and unique means for sharing among a community of humans the distributed nuclei of human resources represented by individuals with special knowledge, judgement, intuition, imagination, conceptual skills, etc. This human-resource sharing has explosive potential -- I look to it with a biological metaphor as providing a new evolutionary stage for the nervous system of social organisms, from which much more highly developed institutional forms may evolve that are much improved in: awareness of self and environment, situational cognizance and response, visualization of the future, problem-solving capability, etc. (See Reference 5 for expansion of this theme.)

12D

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D.C. Engelbart: SRI-ARC Summary for IPT Contractor-Meeting

INTRODUCTION

It is relevant to summarize the basic terms of ARC's current contract with IPT: they were settled upon in June of 1971, and have essentially been in effect through the calendar year of 1972:

Our work is focused entirely on developing and delivering certain types of operational services through the ARPANET -- we are explicitly broadening the range of our work beyond exploratory development to include special, exploratory-application forms both of service/product development and of operational service support.

The services are to support exploratory application of the intellect-augmentation techniques whose evolution and transference to users are the central, continuing vector of the Augmentation Research Center. We are now using the term, "Computer Based Knowledge Workshop" (or simply, "workshop") to refer to the coordinated system of augmentation techniques within which the "knowledge worker" (who is our end-user target) does his "knowledge work." In the contract, the specific service items listed were:

The Network Information Center (NIC)

Dialogue Support

Documentation Production and Control

Software-Engineering Augmentation

System-Developer's Handbook

System-Developer's Baseline Management

Collaborative System Evolution

NOTE: A different and perhaps more useful categorization of the workshop services we now consider is described in in the paper, "Coordinated Information Services for a Discipline- or Mission-Oriented Community," by D.C. Engelbart, 12 Dec 72 (Available from us under ARC/NIC No. 12205, and also to be published in the Proceedings of the Second Annual Computer Communications Conference, San Jose, California, 24 Jan 73).

D.C. Engelbart: SRI-ARC Summary for IPT Contractor-Meeting

For each category of Workshop service we proposed three primary aspects among which we would expend development energy:

Functions -- the repertoire of transactional capabilities, their functional effects, and the control language and protocol involved in each service;

Delivery capability -- the means and techniques that support delivery of such functions to remote users, who would need support from both computer and people services;

Marketing capability -- the means and techniques for setting up and evolving the service-support arrangements, within the shifting, experimental environment of the network community, for interested groups to actually try integrating our services into their work.

IPT support is divided as follows:

Forty percent for the NIC, for both development (of function, delivery, and even a bit of marketing), and for the operational marketing and delivery of its services.

Sixty percent, for developmental work only, in the other service categories -- it being understood that any subsequent operational business in marketing and delivering "workshop support" services to subscribers would be a separate business matter between us and the subscribers.

Our aim is not at all to remove ourselves from the exploratory R&D business: rather we are investing in a strategy that is aimed at several results:

To experiment with new means for consciously pursuing socio-technical innovation;

To experiment with new ways in which discipline- or mission-oriented communities can do their work;

To exercise the ARPANET in its experimentation with the sharing of distributed computational and data resources;

To demonstrate that perhaps the most important resources made "snarable" by a multi-access computer network will be

those represented by the elements of knowledge, skill, judgement, intuition, conceptual skills, etc. distributed among the humans in the Network community;

to promote a more significant and efficient exploration of workshop augmentation needs and possibilities -- among a variety of application groups who can share in the use of a solidly supported base of Workshop-support tools and services, and who can each contribute in important and gratifying ways to the continuing evolution of that workshop base.

WORKSHOP UTILITY DEVELOPMENT

For the past year we have been working toward the establishment of what we call a Workshop Utility service. Its basic, computer-support component is to be furnished through the ARPANET by a TENEX facility at the site of a commercial time-sharing company, who will install, maintain, and operate the facility under contract to us. We will maintain in that facility an especially solid, less-experimental version of NLS, and we will take contracts for its usage.

We sent out an advertised RFP, and ended up with four companies submitting proposals. From among these, we have selected TYMSHARE for next-stage negotiation. Concurrently, we are actively seeking clients to subscribe to the Service -- offering service modules that are fixed proportions of the Utility's computer capacity over a one-year period. Our tentative plan is to launch this service about September, 1973. Along with each portion of NLS computer service, the Workshop Utility will include a certain proportion of technical support.

We aren't going commercial with this enterprise; this is but a step, consistent with the contract provisions described above, toward the aims outlined in Branch (1b). We are looking only for clients of the Workshop Utility who plan to use it in the exploratory mode -- to apply it in prototype applications where it is to their advantage to experiment with a solidly supported but still early model of an augmented Workshop, and/or where it is to our advantage to have their particular experimental applications providing a special kind of orientation, stimulation, feedback, etc. to the benefit of the ongoing Workshop evolution.

The experience and developments outlined below for this past year are all very much relevant to increasing our ability to

support a Network Workshop Utility, and to increasing the value of that Utility to serious-user clientele.

OPERATIONAL RELIABILITY AND EFFICIENCY

Toward these ends we have been investing at least ten percent of our manpower. We have experimented with roles and procedures, with maintenance schedules and policies, and with software conventions and practices. We implemented a relatively comprehensive operating-system measurement system (SUPERWATCH) for TENEX, and have been learning very useful things from analysis of the measurements.

For over six months a seasoned operations research man has been studying both the SUPERWATCH measurements and our user operations; he is helping us understand the dynamics of our service loading, and he has been the architect of a plan involving grouping and resource allocation at an organizational level, together with special TENEX-scheduler conventions and practices, for partitioning and scheduling loads and service. This is an important step toward understanding how to provide sophisticated computer services in a Workshop environment.

DISTRIBUTED-SERVICE EFFORT

Serving a distributed user clientele is a basic problem for any Network Service; and we have been struggling and learning with/about problems and needs. An overwhelmingly strong impression we now have in this respect is that, until the services available to them (including their terminals and their way of using them) become integrated into their way of life like the telephone system now is, the distributed clientele of a powerful computer-support system won't successfully become established or make significant use of the service without a very active effort explicitly involving personal contact and a goodly amount of direct personal support.

This realization has affected our development priorities, and will be reflected as much as possible in the operational services of the Utility. For example, we have known that remote availability of DMLS (Display NLS) would ultimately be very important, but for the NIC we had assumed that most of our clientele wouldn't have the terminal equipment to make use of it, and therefore NIC service has concentrated quite a bit on TNLS (Typewriter NLS).

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For each category of Workshop service we proposed three primary aspects among which we would expend development energy:

1a3

Functions -- the repertoire of transactional capabilities, their functional effects, and the control language and protocol involved in each service;

1a3a

Delivery capability -- the means and techniques that support delivery of such functions to remote users, who would need support from both computer and people services;

1a3b

Marketing capability -- the means and techniques for setting up and evolving the service-support arrangements, within the shifting, experimental environment of the Network community, for interested groups to actually try integrating our services into their work.

1a3c

IPT support is divided as follows:

1a4

Forty percent for the NIC, for both development (of function, delivery, and even a bit of marketing), and for the operational marketing and delivery of its services.

1a4a

Sixty percent, for developmental work only, in the other service categories -- it being understood that any subsequent operational business in marketing and delivering "workshop support" services to subscribers would be a separate business matter between us and the subscribers.

1a4b

Our aim is not at all to remove ourselves from the exploratory R&D business; rather we are investing in a strategy that is aimed at several results:

1b

to experiment with new means for consciously pursuing socio-technical innovation;

1b1

to experiment with new ways in which discipline- or mission-oriented communities can do their work;

1b2

to exercise the ARPANET in its experimentation with the sharing of distributed computational and data resources;

1b3

to demonstrate that perhaps the most important resources made "shareable" by a multi-access computer network will be

those represented by the elements of knowledge, skill, judgement, intuition, conceptual skills, etc. distributed among the humans in the Network community;

to promote a more significant and efficient exploration of workshop augmentation needs and possibilities -- among a variety of application groups who can share in the use of a solidly supported base of Workshop-support tools and services, and who can each contribute in important and gratifying ways to the continuing evolution of that workshop base.

WORKSHOP UTILITY DEVELOPMENT

For the past year we have been working toward the establishment of what we call a Workshop Utility service. Its basic, computer-support component is to be furnished through the ARPANET by a TENEX facility at the site of a commercial time-sharing company, who will install, maintain, and operate the facility under contract to us. We will maintain in that facility an especially solid, less-experimental version of NLS, and we will take contracts for its usage.

We sent out an advertised RFP, and ended up with four companies submitting proposals. From among these, we have selected TYMSHARE for next-stage negotiation. Concurrently, we are actively seeking clients to subscribe to the Service -- offering service modules that are fixed proportions of the Utility's computer capacity over a one-year period. Our tentative plan is to launch this service about September, 1973. Along with each portion of NLS computer service, the Workshop Utility will include a certain proportion of technical support.

We aren't going commercial with this enterprise; this is but a step, consistent with the contract provisions described above, toward the aims outlined in Branch (1b). We are looking only for clients of the Workshop Utility who plan to use it in the exploratory mode -- to apply it in prototype applications where it is to their advantage to experiment with a solidly supported but still early model of an augmented Workshop, and/or where it is to our advantage to have their particular experimental applications providing a special kind of orientation, stimulation, feedback, etc. to the benefit of the ongoing Workshop evolution.

The experience and developments outlined below for this past year are all very much relevant to increasing our ability to

support a Network Workshop Utility, and to increasing the value of that Utility to serious-user clientele.

OPERATIONAL RELIABILITY AND EFFICIENCY

Toward these ends we have been investing at least ten percent of our manpower. We have experimented with roles and procedures, with maintenance schedules and policies, and with software conventions and practices. We implemented a relatively comprehensive operating-system measurement system (SUPERWATCH) for TENEX, and have been learning very useful things from analysis of the measurements.

For over six months a seasoned operations research man has been studying both the SUPERWATCH measurements and our user operations; he is helping us understand the dynamics of our service loading, and he has been the architect of a plan involving grouping and resource allocation at an organizational level, together with special TENEX-scheduler conventions and practices, for partitioning and scheduling loads and service. This is an important step toward understanding how to provide sophisticated computer services in a Workshop environment.

DISTRIBUTED-SERVICE EFFORT

Serving a distributed user clientele is a basic problem for any Network Service; and we have been struggling and learning with/about problems and needs. An overwhelmingly strong impression we now have in this respect is that, until the services available to them (including their terminals and their way of using them) become integrated into their way of life like the telephone system now is, the distributed clientele of a powerful computer-support system won't successfully become established or make significant use of the service without a very active effort explicitly involving personal contact and a goodly amount of direct personal support.

This realization has affected our development priorities, and will be reflected as much as possible in the operational services of the Utility. For example, we have known that remote availability of DNLS (Display NLS) would ultimately be very important, but for the NIC we had assumed that most of our clientele wouldn't have the terminal equipment to make use of it, and therefore NIC service has concentrated quite a bit on TNLS (Typewriter NLS).

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D.C. Engelbart: SRI-ARC Summary for IPT Contractor-Meeting

INTRODUCTION

It is relevant to summarize the basic terms of ARC's current contract with IPT: they were settled upon in June of 1971, and have essentially been in effect through the calendar year of 1972:

Our work is focused entirely on developing and delivering certain types of operational services through the ARPANET -- we are explicitly broadening the range of our work beyond exploratory development to include special, exploratory-application forms both of service/product development and of operational service support.

The services are to support exploratory application of the intellect-augmentation techniques whose evolution and transference to users are the central, continuing vector of the Augmentation Research Center. We are now using the term, "Computer Based Knowledge Workshop" (or simply, "workshop") to refer to the coordinated system of augmentation techniques within which the "knowledge worker" (who is our end-user target) does his "knowledge work." In the contract, the specific service items listed were:

The Network Information Center (NIC)

Dialogue Support

Documentation Production and Control

Software-Engineering Augmentation

System-Developer's Handbook

System-Developer's Baseline Management

Collaborative System Evolution

NOTE: A different and perhaps more useful categorization of the Workshop services we now consider is described in in the paper, "Coordinated Information Services for a Discipline- or Mission-Oriented Community," by D.C. Engelbart, 12 Dec 72 (Available from us under AKC/NIC No. 12245, and also to be published in the Proceedings of the Second Annual Computer Communications Conference, San Jose, California, 24 Jan 73).

For each category of Workshop service we proposed three primary aspects among which we would expend development energy:

Functions -- the repertoire of transactional capabilities, their functional effects, and the control language and protocol involved in each service;

Delivery capability -- the means and techniques that support delivery of such functions to remote users, who would need support from both computer and people services;

Marketing capability -- the means and techniques for setting up and evolving the service-support arrangements, within the shifting, experimental environment of the network community, for interested groups to actually try integrating our services into their work.

IPT support is divided as follows:

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Sixty percent, for developmental work only, in the other service categories -- it being understood that any subsequent operational business in marketing and delivering "workshop support" services to subscribers would be a separate business matter between us and the subscribers.

Our aim is not at all to remove ourselves from the exploratory R&D business; rather we are investing in a strategy that is aimed at several results:

to experiment with new means for consciously pursuing socio-technical innovation;

to experiment with new ways in which discipline- or mission-oriented communities can do their work;

to exercise the ARPANET in its experimentation with the sharing of distributed computational and data resources;

to demonstrate that perhaps the most important resources made "shareable" by a multi-access computer network will be

D.C. Engelbart: SRI-ARC Summary for IPT Contractor-Meeting

A workable network DNLS was eventually developed in time for the ICCG (with specially programmed IMLAC terminals, and thanks to generous last-ditch push by Peter Deutsch of xerox).

we have for some years had DNLS features that allowed people at two different consoles to link screens, and by simultaneously talking on a telephone they could collaborate as though standing together in front of a (very special) blackboard. For the ICCG, we made the necessary modifications so that this feature would work on the IMLAC terminals, too.

subsequently, we have used this feature to work with people at RADC (in Rome, New York), who are just beginning to experiment with Network-supported DNLS. This shared-screen mode of dialogue turned out to be such a powerful means (dramatically so) of providing direct personal support, that it makes clear to us that every Workshop Utility client site should be equipped with at least one DNLS terminal to support this kind of direct, personal help from the Utility (not to speak of the significant value for use in tele-conferencing dialogue among fellow Workshop Utility clientele).

Among the other developments we made toward improved, distributed service were the following:

special means for directing formatted-page output to local printers tied to a TIP, including page-at-a-time delivery to typewriters not using pin-feed paper.

A very simple "query" interface to NLS files, allowing search through NLS reference files (especially the NIC locator set) with essentially no training (except for how to reach us through the TIP and how to log into TENEX).

improvements to the IDENT and distribution facilities of the NIC Journal.

A highly automated process for producing NIC catalogs

close involvement with development of the Network File Transfer Protocol -- which is an important ingredient in the kinds of information services both NIC and the Workshop Utility will offer. For example, to transfer files generated from other editing systems into the Journal for distribution, cataloging, and archiving; or for delivering

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D.C. Engelbart: SRI-ARC Summary for IPT Contractor-Meeting

online Journal memos to the recipient's site for printout; or for using special Network file-management resources to store our ever-growing collection of online material.

WORKSHOP FUNCTION DEVELOPMENT

Professional-quality, computer-typeset publication via our Output Processor and a commercial service bureau (using a III Comp-80) has been a steady development activity with us. We are now setting up for publishing our NIC documentation this way, and also struggling as amateur typographers to set up our latest project report.

The typography-control directives added to the output processor give us such a wide choice for type of font, size, density, and page position, that the early experiments produced very wild results. That serious typography is a full profession can readily be appreciated.

When he gets to the final type-setting pass in producing a manuscript, almost every client of the Utility will clearly need specialist help if he deviates much at all from some standard format for his type of material. The ability to obtain such help from a remote specialist, via real-time teleconferencing using the shared-screen dialogue, is a beautiful example of the benefits the Network will bring for human-resource sharing.

Economical generation and updating of online files, whether for document development or data management, is another thing in which we have been steadily investing.

We have continued a low-grade effort, recently stepped up, to evolve what we call PEX (for Deferred Execution system) as a supplementary workshop facility. We currently spool the input from online-type typewriters onto magnetic cassettes. Paper tape works, too, and likely the clerical support for a cluster of knowledge workers would find a mini-computer, working in a low-feedback spooling mode, effective for PEX-input purposes.

Almost the whole range of NLS functions are specifiable, and the logic of the batch-executed DEX control processes has been developed to put the burden on the run-time "compiler" to worry about what the current address of a target item might be, in view of the alterations specified up to this point in this batch entry.

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I claim that a skilled clerk-typist will learn DEX very handily, and can be significantly more efficient in terms of keyboard time and computer-resource consumption, for many basic types of file-development work, than the most-skilled DNLS user. We discovered many years ago that in an important number of cases involving heavy reworking of manuscript drafts, it was an advantage to have DEX-like systems that didn't talk back to the operator; to make use of the feedback took the operator's attention away from the input material, and for later scanning of the typed-input record the feedback typing represented distracting "noise".

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Calculation is a basic sort of knowledge workshop task. For heavy computation our workshop would provide useful support in formulating, studying, documenting, etc. of the models and computer programs, but we would count on shipping the computation out (through the Network) to systems that were built to do that kind of work.

5c

But in the range covering needs where people now turn to slide rules, little desk calculators, and perhaps to the simpler applications of BASIC programs, it is feasible and valuable to include special calculation-support tools in the workshop environment. We have been working on such as an addition to NIS. Early developments in this regard demonstrate immediately that they can be extremely valuable.

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NETWORK INFORMATION CENTER

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Although the qualitative nature of NIC-service functions has changed but little during the year, we have learned a great deal, have developed substantially more reliable operational support, and improved efficiencies. We have taken over the job of maintaining the Network Resource Notebook that was effectively begun by BBN, and are pushing heavily upon extending the scope, depth, and accuracy of its coverage. Our information-output service load is still predominantly offline, and involves a lot of NIC-staff interaction with clients: we have 132 addressees to whom we mail regularly, about five items a week (54 Network Liaison people, 48 Station Agents, and 30 Associates -- individuals who aren't ARPANET but who are involved actively in network technology).

6a

We maintain special circulation lists (full addresses, telephone numbers, etc) and provide online or hard-copy distribution of intra-group memos to 15 special-interest groups, four of whom are becoming quite active in using this

mode of dialogue: The ARPANET Satellite Systems Group (18 members), the Computer Based Instruction Group (28), the International Network Group (29), and the Speech Understanding Research Group (26).

6b

We are beginning an interesting experiment with ACM's AI SIG, who have for some time been publishing a newsletter in a conventional manner. They have taken steps to use the NIC Journal to get early releases of articles put online and to facilitate online commentary. We hope ultimately to be able to support their direct publication from online files.

6c

We maintain relatively comprehensive "ident" data for a total of 366 registered individuals, affiliation organizations, and working groups, and somehow have a telephone directory with 530 phone numbers. All of these data are accessible via DNLS and TNLS, and much of it with the very easily used QUERY subsystem. Updating these data is a religiously maintained activity.

6d

NIC monthly pays a telephone bill of about \$700, and a mailing bill of between \$800 and 1300; it also runs about 5000 sheets a week out of its own Xerox machine, besides paying about \$300 per month for outside reproduction costs.

6e

Each Station Agent requires special introductory help; only a few have been sent to SRI to learn -- most of them have a lot of telephone talk at first, and we try to call them regularly to check up on things. We have run about seven TNLS classes, and one DNLS class, at our site; and have been learning about off-site teaching with the group at RADC.

6f

We invested very heavily in ICCG participation; many people (more than just our NIC group) worked for three to five months preceding the conference, and twelve of us spent the week in Washington. We considered the event to be highly successful, and very much worth whatever we all spent on making it come off.

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Jan 73

COORDINATED INFORMATION SERVICES
for a
DISCIPLINE- OR MISSION-ORIENTED COMMUNITY

by

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